ENERGY SAVING LAMP

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ABSTRACT

In our daily life, lamp is very synonym with us. Lamp is very useful especially when in the dark environment. In the modern era, there are many types of lamp. First lamp that had been used is filament lamp. After that pendarflour lamp had been used due to the low cost and it's brighter than filament lamp. Even, another type of lamp had been introduced, that is LED lamp. This type of lamp is having longer life span compared to filament lamp and the pendarflour lamp. Besides that, this lamp is more economical compared to the pendarflour lamp. One of the problem about this lamp, it is hard to find this type of lamp in market. Due to this, the price also expensive. In my project, I use LED as my lamp. To make my project more applicable, I used 9V rechargeable battery. Usually all the battery charger have controller to control the flow of charging process. For my project, I used op-amp as the controller. This controller will cut off the charging process when the battery achieves 9.2V. Besides that, to make the lamp more efficient, one more controller circuit had been developing. This circuit acts as the automatic switch which only will allow the lamp ON when there are no falling light on the Light Dependent Resistor, LDR. With this switching method it will make the use of the lamp is more efficient and economical.

ABSTRAK

Dalam kehidupan harian kita, lampu merupakan sesuatu yang amat rapat dengan kita. Lampu amat berguna apatah lagi apabila kita berada di dalam suasana yang gelap. Di zaman yang serba moden ini terdapat pelbagai jenis lampu. Pada asalnya lampu berfilamen merupakan pilihan yang selalu digunakan. Tetapi setelah kemajuan dalam bidang sains, lampu berpendarflour menjadi pilihan ramai pengguna kerana ianya dapat mengurangkan kos elektrik dan juga lebih terang dari lampu filament. Namun begitu, satu lagi teknologi lampu yang cuba diketengahkan iaitu lampu LED. Lampu ini lebih tahan lama jika hendak dibandingkan dengan lampu filament dan lampu pendarflour. Selain itu lampu ini juga lebih jimat dari segi penggunaan elektrik jika dibandingkan dengan lampu pendarflour. Tetapi masalahnya lampu ini jarang didapati dipasaran dan harganya juga agak mahal. Dalam projek yang saya lakukan, saya menggunakan LED sebagai lampu. Untuk membolehkan penggunaan lampu lebih berleluasa, bateri digunakan bagi membuatkan ianya mudah dibawa ke mana sahaja. Selain itu bateri yang digunakan juga adalah bateri yang boleh dicas semula bagi menjimatkan kos pembelian bateri. Di dalam projek yang saya buat, saya menggunakan bateri 9V yang boleh dicas semula. Pengecas bateri biasanya terdapat satu unit pengawal yang akan menentukan samada bateri itu sudah penuh atau tidak. Dalam projek yang saya buat, pengawal tersebut adalah Op-amp. Pengawal ini akan menghentikan proses mengecas apabila bateri mencapai voltan 9.2 volt. Selain itu, bagi membuatkankan penggunaan lampu lebih efisien, satu litar pengawal yang hanya membenarkan lampu menyala ketika gelap telah dibuat. Ianya menggunakan konsep iaitu lampu hanya akan menyala jika tiada cahaya yang dikesan oleh Light Dependent Resistor, LDR. Dengan adanya system pensuisan sebegini, ia akan membuatkan penggunaan lampu lebih efisien dan menjimatkan.

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CHAPTER 1

INTRODUCTION

1.1 Overview

This project comprises three sections, power supply, charging circuit and lamp control. The output voltage of the power supply is 12V. It used to charge the battery and power the lamp control circuit. For the charging circuit, it charges the 9V rechargeable battery. The function of the rechargeable battery is to make this device portable.

Lamp controlling circuit is the switching circuits which only allow the lamp ON when there are no light falling on LDR. Leaving the lights on when no one is in the room is a huge waste of energy and money. The less time you spend with the lights on, the more energy you save.

To minimize the energy used by the lamp, LED lamp had been used. When compared, incandescent bulbs (1000 hours of life) can't beat LEDs (up to 60,000 hours.). It could save some energy, and some money. Furthermore LED bulbs are closer to the color of daylight which new studies suggest is good for staying alert. LEDs not only produce light more efficiently, they also have a tiny mirror that reflects light in one direction. A more directed light means less wasted light. With LED light bulbs and just a bit of planning we can create a more interesting lighting environment while cutting down on your electric bill.

1.2 Objectives

The main objectives are:

I. To apply theoretical knowledge that has been learn into the real situation.

II. Learn how to use the simulation software before using the components in the hardware.

III. To analyze the using of the LED light in the daily life.

1.3 Scope of Project

The scopes of this project are to develop 12Vdc power supply circuit, charging circuit and lamp controller circuit only based on theoretical knowledge that had been learn. By using the simulation software, the circuit which had been developed has been testing before install it in the actual circuit. After all hardware fully install, the theoretical value from the simulation and the actual value from the hardware is been compared. Analysis will be done based on the data that had been collected.

1.4 Problem Statement

In power supply project, the major problems occur when designing the circuit is the supply is not stabilizing. When this kind of supply use for sensitive equipment like controller, usually the output from that device is not stable. For battery charger, the most important things to design it is the method to cut-off the supply to stop the charging process. This is to make sure the life time of the battery longer. Besides that, there are a few things that we must consider, that are temperature and charging time. The switching method is the important requirement to make sure we use the lamp efficiency. Good switching make more saving in term of energy and money.

1.5 Thesis Organization

This thesis consists of five chapters. Chapter1 is about the introduction, chapter2 about literature review, chapter3 about methodology, chapter4 about result and discussion and chapter5 for conclusion and recommendation.

CHAPTER 2

LITERATURE REVIEW

Power supply circuit:

This project power supply consists of four part, transformer, rectifier, filter and ic regulator. The transformer step down the voltage from 240V_{rms} to 15$V_{rms.}$

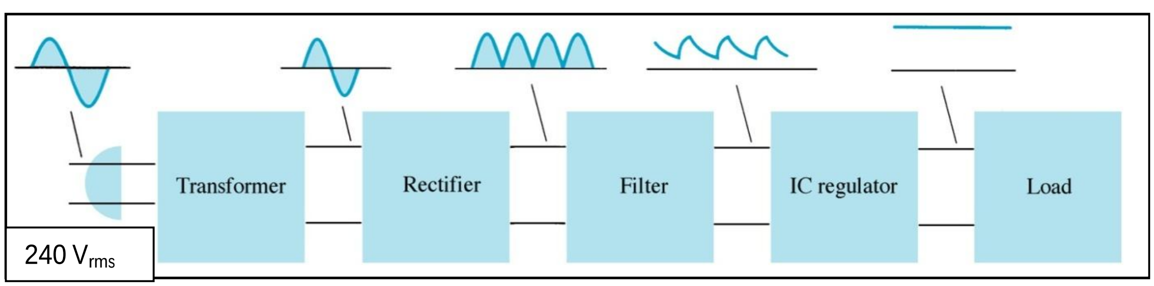

Figure 2.1: Power supply

2.1: Rectifier

A rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid state diodes, vacuum tube diodes, mercury arc valves, and other components.

When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform), the difference between the term diode and the term rectifier is merely one of usage, i.e., the term rectifier describes a diode that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper (I) oxide or selenium rectifier stacks were used.

Early radio receivers, called crystal radios, used a "cat's whisker" of fine wire pressing on a crystal of galena (lead sulfide) to serve as a point-contact rectifier or "crystal detector". In gas heating systems flame rectification can be used to detect a flame. Two metal electrodes in the outer layer of the flame provide a current path and rectification of an applied alternating voltage, but only while the flame is present.

2.1.1: Half-wave rectification

In half wave rectification, either the positive or negative half of the AC wave is passed, while the other half is blocked. Because only one half of the input waveform reaches the output, it is very inefficient if used for power transfer. Half-wave rectification can be achieved with a single diode in a one phase supply, or with three diodes in a three-phase supply.

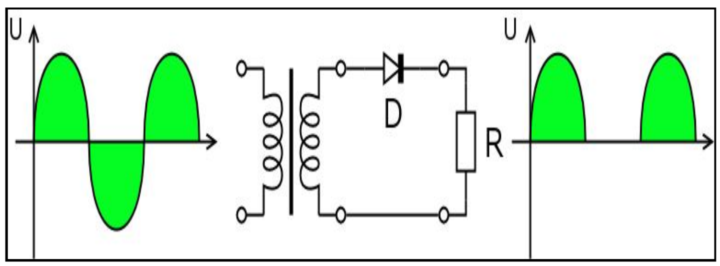

Figure 2.2: Half-wave rectification

2.1.2: Full-wave rectification

A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output. Full-wave rectification converts both polarities of the input waveform to DC (direct current), and is more efficient. However, in a circuit with a non-center tapped transformer, four diodes are required instead of the one needed for half-wave rectification. Four rectifiers arranged this way are called a diode bridge or bridge rectifier:

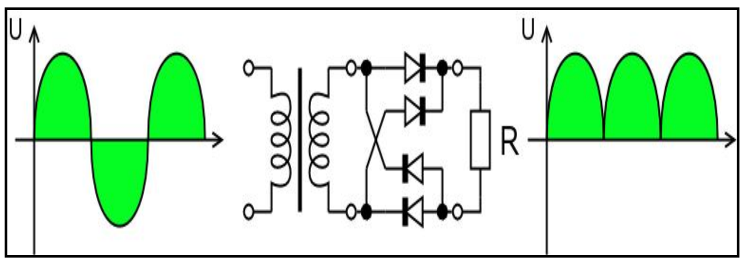

Figure 2.3: Full-wave rectification

For single-phase AC, if the transformer is center-tapped, then two diodes back-to-back (i.e. anodes-to-anode or cathode-to-cathode) form a full-wave rectifier (in this case, the voltage is half of that for the non-tapped bridge circuit above, and the diagram voltages are not to scale).

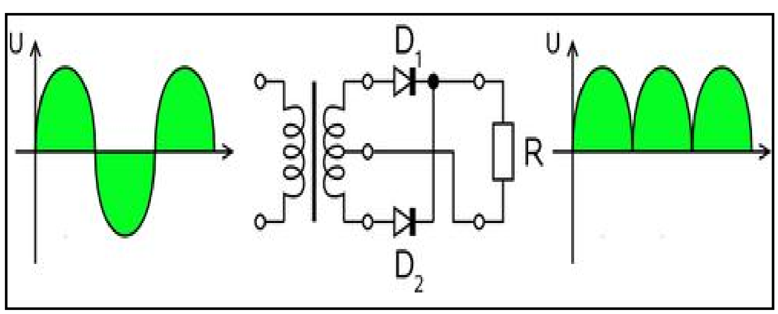

Figure 2.4: Center-tapped

2.2: Filter

2.2.1: The Capacitor Filter

The simple capacitor filter is the most basic type of power supply filter. The application of the simple capacitor filter is very limited. It is sometimes used on extremely high-voltage, low-current power supplies for cathode-ray and similar electron tubes, which require very little load current from the supply. The capacitor filter is also used where the power-supply ripple frequency is not critical, this frequency can be relatively high. The capacitor (C1) shown in figure 2.5 is a simple filter connected across the output of the rectifier in parallel with the load.

When this filter is used, the RC charge time of the filter capacitor (C1) must be short and the RC discharge time must be long to eliminate ripple action. In other words, the capacitor must charge up fast, preferably with no discharge at all. Better filtering also results when the input frequency is high; therefore, the full-wave rectifier output is easier to filter than that of the half-wave rectifier because of its higher frequency.

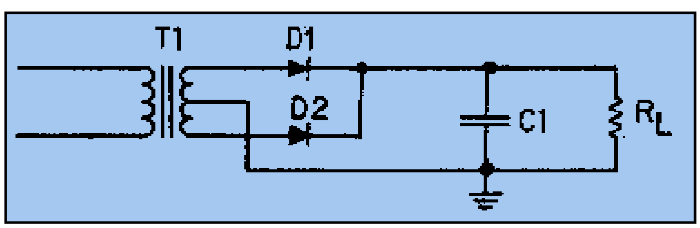

Figure 2.5: Full-wave rectifier with a capacitor filter.

For you to have a better understanding of the effect that filtering has on E_{avg}, a comparison of a rectifier circuit with a filter and one without a filter is illustrated in figure 2.6 and figure 2.7. The output waveforms in both figures represent the unfiltered and filtered outputs of the half-wave rectifier circuit. Current pulses flow through the load resistance (R_L) each time a diode conducts. The dashed line indicates the average value of output voltage. For the half-wave rectifier, E_{avg} is less than half (or approximately 0.318) of the peak output voltage. This value is still much less than that of the applied voltage. With no capacitor connected across the output of the rectifier circuit, the waveform in figure 2.6 has a large pulsating component (ripple) compared with the average or dc component. When a capacitor is connected across the output figure 2.7, the average value of output voltage (E_{avg}) is increased due to the filtering action of capacitor C1.

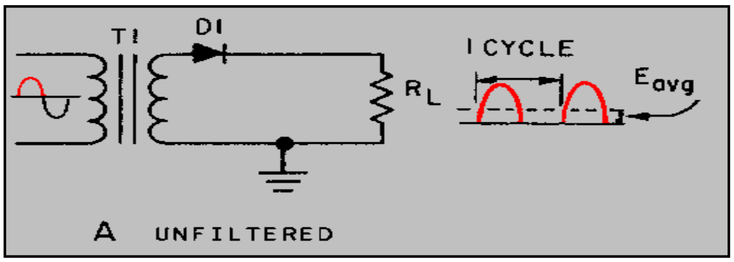

Figure 2.6 - Half-wave rectifier without filtering.

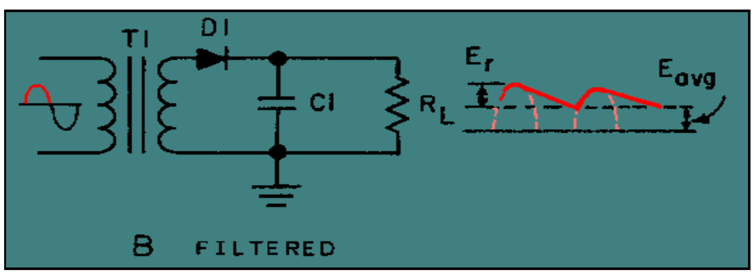

Figure 2.7 - Half-wave rectifier with filtering.

The value of the capacitor is fairly large (several microfarads), thus it presents a relatively low reactance to the pulsating current and it stores a substantial charge.

2.2.2: Resistor-Capacitor (RC) Filters

The RC capacitor-input filter is limited to applications in which the load current is small. This type of filter is used in power supplies where the load current is constant and voltage regulation is not necessary. For example, RC filters are used in high-voltage power supplies for cathode-ray tubes and in decoupling networks for multistage amplifiers.

Figure 2.8 shows an RC capacitor-input filter and associated waveforms. Both half-wave and full-wave rectifiers are used to provide the inputs. The waveform shown in view A of the figure represents the unfiltered output from a typical rectifier circuit. Note that the dashed lines in view A indicate the average value of output voltage (E_{avg}) for the half-wave rectifier. The average output voltage (E_{avg}) is less than half (approximately 0.318) the amplitude of the voltage peaks. The average value of output voltage (E_{avg}) for the full-wave rectifier is greater than half (approximately 0.637), but is still much less than, the peak amplitude of the rectifier-output waveform. With no filter circuit connected across the output of the rectifier circuit (unfiltered), the waveform has a large value of pulsating component (ripple) as compared to the average (or dc) component.

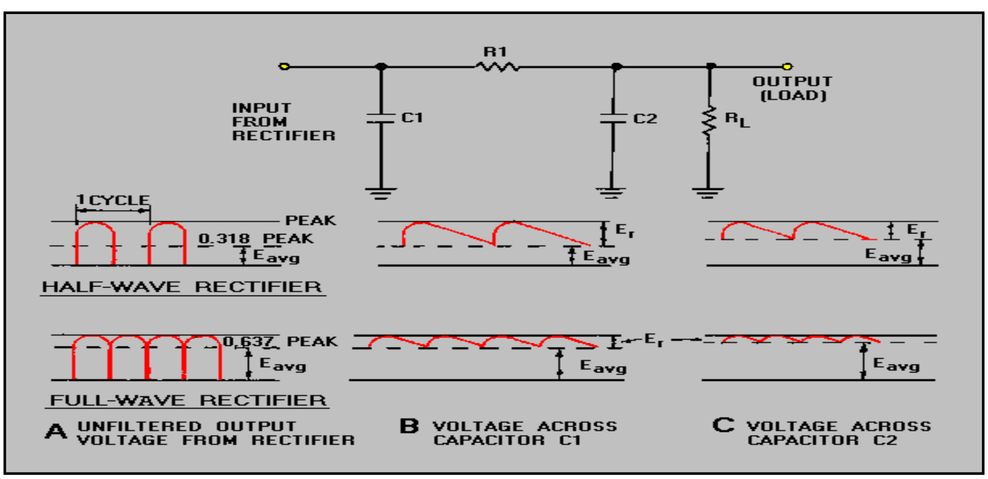

Figure 2.8 - RC filter and waveforms.

The RC filter in figure 2.8 consists of an input filter capacitor, C1, a series resistor, R1, and an output filter capacitor, C2. (This filter is sometimes referred to as an RC pi-section filter because its schematic symbol resembles the Greek letter p).

The single capacitor filter is suitable for many noncritical, low-current applications. However, when the load resistance is very low or when the percent of ripple must be held to an absolute minimum, the capacitor value required must be extremely large. While electrolytic capacitors are available in sizes up to 10,000 microfarads or greater, the large sizes are quite expensive. A more practical approach is to use a more sophisticated filter that can do the same job but that has lower capacitor values, such as the RC filter.

Views A, B, and C of figure 2.8 show the output waveforms of a half-wave and a full-wave rectifier. Each waveform is shown with an RC filter connected across the output. The following explanation of how a filter works will show you that an RC filter of this type does a much better job than the single capacitor filter.

C1 performs exactly the same function as it did in the single capacitor filter. It is used to reduce the percentage of ripple to a relatively low value. Thus, the voltage across C1 might consist of an average dc value of +100 volts with a ripple voltage of 10 volts peak-to-peak. This voltage is passed on to the R1-C2 network, which reduces the ripple even further.

C2 offers an infinite impedance (resistance) to the dc component of the output voltage. Thus, the dc voltage is passed to the load, but reduced in value by the amount of the voltage drop across R1. However, R1 is generally small compared to the load resistance. Therefore, the drop in the dc voltage by R1 is not a drawback.

Component values are designed so that the resistance of R1 is much greater than the reactance (X_C) of C2 at the ripple frequency. C2 offers very low impedance to the ac ripple frequency. Thus, the ac ripple senses a voltage divider consisting of R1 and C2 between the output of the rectifier and ground. Therefore, most of the ripple voltage is dropped across R1. Only a trace of the ripple voltage can be seen across C2 and the load. In extreme cases where the ripple must be held to an absolute minimum, a second stage of RC filtering can be added. In practice, the second stage is rarely required. The RC filter is extremely popular because smaller capacitors can be used with good results.

The RC filter has some disadvantages. First, the voltage drop across R1 takes voltage away from the load. Second, power is wasted in R1 and is dissipated in the form of unwanted heat. Finally, if the load resistance changes, the voltage across the load will change. Even so, the advantages of the RC filter overshadow these disadvantages in many cases.

- For this circuit, it used capacitor filter to reduce the peak-to-peak pulses to a small ripple voltage.

2.3: Voltage regulator

2.3.1: Series voltage regulator

The schematic for a typical series voltage regulator is shown in figure 2.9. Notice that this regulator has a transistor (Q1) in the place of the variable resistor. Because the total load current passes through this transistor, it is sometimes called a "pass transistor." Other components which make up the circuit are the current limiting resistor (R1) and the Zener diode (CR1).

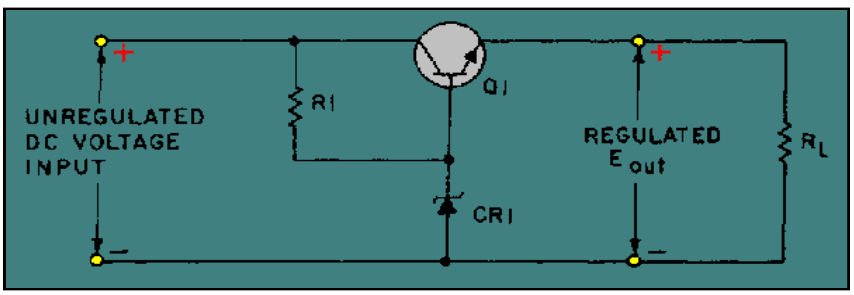

Figure 2.9 - Series voltage regulator.

Recall that a Zener diode is a diode that block current until a specified voltage is applied. Remember also that the applied voltage is called the breakdown, or Zener voltage. Zener diodes are available with different Zener voltages. When the Zener voltage is reached, the Zener diode conducts from its anode to its cathode (with the direction of the arrow).

In this voltage regulator, Q1 has a constant voltage applied to its base. This voltage is often called the reference voltage. As changes in the circuit output voltage occur, they are sensed at the emitter of Q1 producing a corresponding change in the forward bias of the transistor. In other words, Q1 compensates by increasing or decreasing its resistance in order to change the circuit voltage division.

Refer figure 2.10, voltages are shown to help you understand how the regulator operates. The Zener used in this regulator is a 15-volt Zener. In this instance the Zener or breakdown voltage is 15 volts. The Zener establishes the value of the base voltage for Q1. The output voltage will equal the Zener voltage minus a 0.7-volt drop across the forward biased base-emitter junction of Q1, or 14.3 volts. Because the output voltage is 14.3 volts, the voltage drop across Q1 must be 5.7 volts.

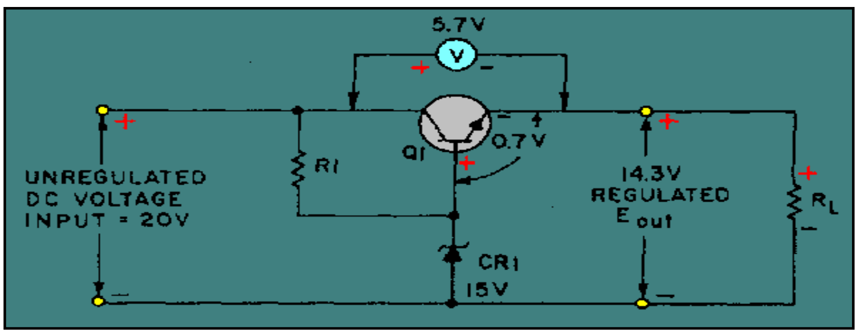

Figure 2.10 - Series voltage regulator (with voltages).